Don Lancaster's

Tech Musings

September, 1997

Reading web site log files
New self-calibrating opamp
Hand bookbinding resources
Intrepreting HTML error codes
Making low level measurements

Take your choice of a large "petrovoltaic" rock, a junk electrolytic cap, or anything else handy. Then measure the voltage across any of these and record those variations against time.

See a few millivolts of diurnal and other mysterious cycles.

Depending on where you look on the web, you'll find conclusions that you have seen scalar gravity waves, Uncle Louie's ghost, overunity zero point energy sources, extraterrestral communications, or new geological phenonema. In reality, what you'll probably have is some other and far more obvious noise effect completely hiding what you think you see.

That crucial difference between serious research and pseudoscience is this: Whenever a real scientist or a real engineer gets a controversial or a strange result, they should promptly spend monumental time and effort in *proving themselves wrong.*

Finding out exactly where and how their measurements lied.

Your pseudoscience "practitioner" instead runs out and starts gathering investors or getting on late night talk shows. For these folks are genuinely convinced they are "right" and often insist it is up to the rest of the world to drop everything they're doing. Just to find out that an obvious and "not even wrong" mistake was made.

So, I guess it may be way past time to review…

Measuring Low Level Signals

It is trivially easy to trash up *any* low voltage measurement. Especially when high impedances are involved. I've summarized some steps you can take to avoid several more glaringly obvious problems in figure one.

Some problem areas are…

Know your op amps–Typical op amps have an input dc offset error of a few millivolts. At higher gains, offset can cause several *volts* of output error or level shift. This offset is highly time and temperature dependent. Op amp noise very much depends upon your source impedance and goes sharply *up* at very low frequencies. A badly chosen "low noise" op amp can end up *much* noisier than a regular one.

Always work differential–If you use a *balanced* or *differential* circuit, your input signal appears as the *difference* across an opposed *pair* of amplifying devices. Any interfering or *common mode* signals that bounce both inputs up and down together will be pretty much ignored. One multiple opamp *instrumentation amplifier* circuit is particularly adept at processing low level differential signals.

Carefully shield and guard– Sensing leads to any input should always be as short as possible and get carefully shielded. Against both electric and magnetic fields. Analog and digital grounds do have to be kept strictly separate. It is extremely important to *prevent any ground trace noise from ending up in series with your sensed input!* Finest shielding of all comes from *driven guards*, where shielding gets *actively powered* from a unity gain and low impedance copy of the actual input signal. This forces zero volts (and thus zero current) between signal and shield.

Know your noise floor–If you turn up any amplifier loud enough, you will get output. Every time. And a lot of it will not appear to be all that random. You'll usually see thermal noise from the input resistance, first stage noise additions, hum, interference, local radio stations, excessive bandwidth, microphonics, poor shielding, nearby computers, and anything electronic within a few miles. Always be able to show your noise floor and know your signal-to-noise ratio.

Quickly go digital–The more analog parts to your circuit, the more will be your possibilities for noise, drift and interference. Always do your digital

1 – Know your opamp's offset, offset drift, noise voltage, and noise currents.
2 – *Always* use balanced differential inputs in an "instrument" configuration.
3 – For lowest noise, carefully match your opamp to your source impedance.
4 – Be certain all supply pins are thoroughly bypassed and decoupled.
5 – Effective electric and magnetic shielding is a must.
6 – *Never* permit *any* ground currents in series with your inputs.
7 – Thoroughly separate all of your analog and digital grounds.
8 – Consider using active guarding instead of grounded shields.
9 – Know your system noise floor and noise sources, both external and internal.
10 – Restrict bandwidth to only that needed for an effective measurement.
11 – Convert to digital as near to the front end and at as low a level as possible.
12 – Suspect *all* capacitors. *Never* use an electrolytic in a low level signal path!
13 – Isolate low level circuitry with optocouplers or special isolation amps.
14 – Consider using carriers, lock-in amps, sync demods, or autocorrellation.
15 – *Always* assume controversial results are dead wrong. *Blame yourself first!*
16 – *Always* use *Ockham's Razor* to seek the simplest explanations.
17 – *Always* seek independent third party verification.
18 – *Never* jump to conclusions!

Fig. 1 – MY GUIDELINES for lab measurement of low level signals.

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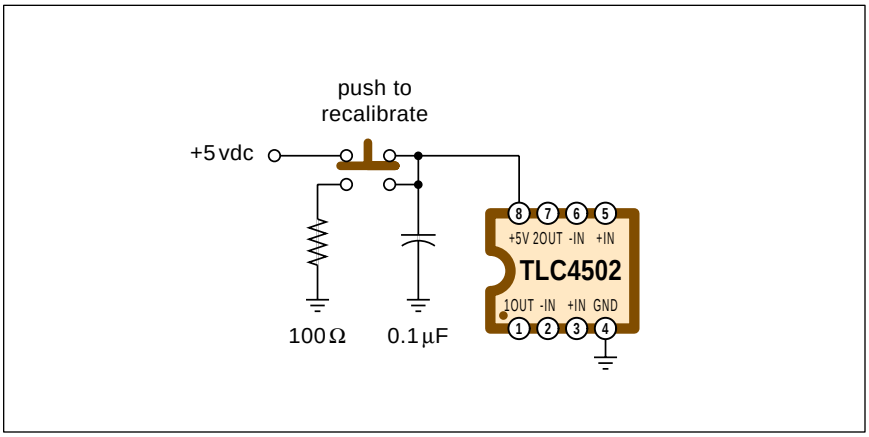


Fig. 2 – THE TLC4502 LOOKS AND ACTS like any other $2 dual operational amplifier. Except it automatically measures and then cancels out its input offset on power up. Run time offsets are an astonishingly low fifty microvolts max with a temp drift under one microvolt per degree C.

conversion as early as possible at the lowest possible level. *Analog Devices* has a number of signal conditioning chips that are ideal for this.

Isolate–Long test leads or excessive electronics near what is being sensed can very much affect what you'll see. One option is to build your sensing electronics as small as possible, and then opto isolate them using an IRDA driver or whatever. Special isolation amplifiers are also available through *Burr Brown* and others that also will nearly completely isolate a front end sensor from the rest of your system.

Suspect all capacitors–Electrolytic caps are a witches' brew of chaotic and nonlinear electrochemistry. They should *never* get used in low level signal or filter paths. Other caps have "bounceback", memory, and electret effects that depend upon the previous charge history.

Some respond more than others to temperature, motion, voltage, stress, humidity, or pressure. Or may act as microphones, seismometers, or even as piezeo actuators.

Watch circuit details–Opamps have gain and phase margins which might become unstable with certain loads and certain feedback combinations. *Know all these margins!* Supply pins should always be well bypassed and decoupled as close to your chips as possible. Do prevent all unintentional feedback through a careful pc board routing that keeps outputs far away from any inputs.

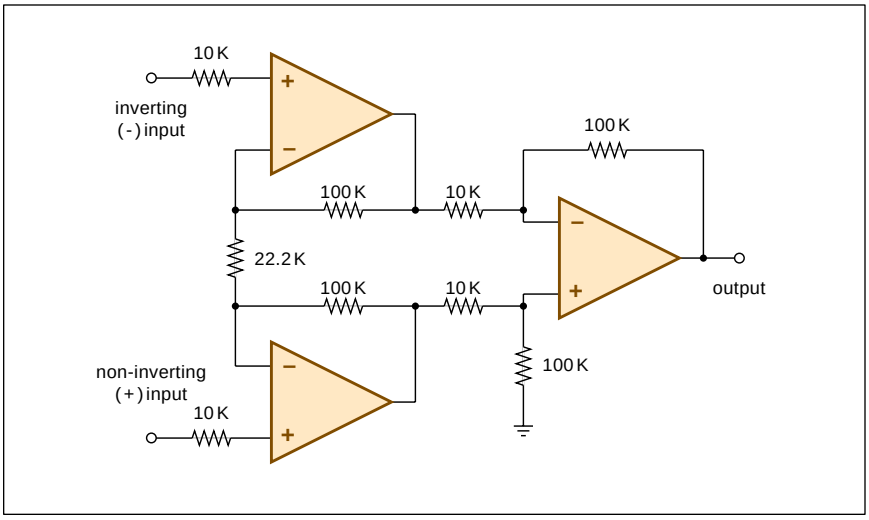


Fig. 3 – "INSTRUMENT OPAMP CONNECTION" has balanced differential inputs, extreme input impedance and identical phase delay on both inputs. Values shown give a voltage gain of 100. Use 1% resistors.

Consider a carrier–By modulating a desired signal onto an input carrier, drift and excess low frequency noise can often be eliminated. Narrow band filtering can also end up much easier.

While such techniques were once called *lock-in amplifiers*, modern aps apply digital *autocorrelation*, *phase lock loops*, or *sync demods*.

Don't jump to conclusions–Even when you're cleanly measuring *some* low voltage, a signal can easily have a wildly different source than you think it does. Always use *Ockham's Razor* to pick the simplest and most obvious possible answers first. And always seek an independent check of some sort to *fully* verify that what you think you have is really there.

More on dealing with "too good to be true" results in HACK87.PDF More on this pseudoscience stuff is in the *PseudoScience Library Shelf* and the *Oddball Pseudoscience Links* found on my http://www.tinaja.com

A Self-zeroing Op Amp!

As we've just seen, all operational amplifiers have an unavoidable *input offset*. A typical offset in a low cost opamp might be five millivolts with a temperature drift of 100 microvolts per degree C. One cause of this offset is a slight and unavoidable mismatch between the bipolar transistors or FET devices on the non-inverting and inverting inputs.

At high gains, such an offset can generate several *volts* of dc *output* offset. One way to measure the offset of a higher gain op amp is to simply short your inputs and measure your output level. Some op-amps bring out offset adjustment pins which let you purposely introduce an unbalance to take out most of the offset. So long as the temperature doesn't change.

Well, *Texas Instruments* has just gone a giant step further. With their TLC4502 *self calibrating* opamp.

Per the details in figure two.

This chip looks and behaves like nearly any other $2 small outline dual rail-to-rail op amp. Except for a key difference: On power up, a special routine is gone into that temporarily

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The ACCESS log –

Each text line in the access log file consists of a site *hit*.
A hit is one access to a site requesting a single page or file.

A typical *name addressed* hit line may look like this…

drooper.mcb.com - - [01/Jun/1997:20:15:06] "GET / file5.pdf HTTP/1.0" 200 14234

Or a hit line might use a *nuemric address* such as…

145.65.224.42 - - [01/Jun/1997:20:15:06] "GET / file5.pdf HTTP/1.0" 200 14234

Either way, everything up to the first "[" is the client doing the requesting. Everything in the brackets is the time and date. Everything in quotes is the requested action, followed by the requested protocol.

The three-digit number that follows is the HTML error or status code. Code "200" is a normally filled request and is followed by the number of bytes transferred. Other codes do not transfer bytes and are followed by a hyphen.

The ERROR log –

Each line of an error log reports one client problem.

Here is an error line caused by some network difficulty…

[Thu Jun 19 16:19:31 1997] send timed out for 143.86.15.97

Here is an error line caused by a possible bad link on your site…

[Thu Jun 19 16:21:11 1997] access to usr / home / finedemo failed for scott.mmn.edu

In either case, the initial brackets hold the time and date. The rest of the line explains the problem and the client that was involved.

Fig. 4 – READING HTML LOG FILES from an Apache server. Newer servers may include additional info. Such as referral sites or client software.

shorts the op amp inputs. At the same time, the output is opened.

The input offset voltage is then measured and *digitally* saved. A mere 0.3 seconds later, the op amp returns to "normal" behavior. But with input offsets of 50 microvolts and an offset drift of a really amazing 1 microvolt per degree C!

Which is a 100:1 improvement.

It gets better. The unity gain slew rate is 2.5 volts per microsecond, the noise 12 nanovolts per $Hz^{0.5}$ and the supply current is only a mil and a half per amplifier. Open loop gain is 120 decibels, and an amp can drive lK and 0.001 microfarads rail to rail. The larger pulse settling time is around twenty microseconds. Small pulses can settle ten times faster. Harmonic distortion is 0.08 percent, specified at a gain of ten.

Inputs can be at ground. Signals up to 100 kiloHertz output rail-to-rail. Output impedance is less than a tenth of an Ohm. Their gain bandwidth product is 4.5 Megahertz.

Output short circuit protection is built in and self-resetting. Supply voltage is +4 to +6 volts. Input offset current and input bias current are less than 500 *pico*amperes! Their input resistance is an outstanding twelve *million* megohms.

You can recalibrate any time by removing the supply voltage.

All these strange numbers tell us we have an amazing quantum leap in op amp technology here. Especially for cost sensitive, higher impedance uses at mid audio frequencies. Lots of use examples appear on the data sheet. Several instrument amplifiers, current sources, and peak detectors are included. A clone of their classic instrument amplifier appears here as figure three.

Freebie TLC4502 samples can be gotten from *Texas Instruments*.

New Technical Book Source

Butterworth Heineman has opened a new technical paperback series in their *Newnes* offprint. Many dozens of new and updated titles appear in a free catalog. From an international stable of well known authors.

Several titles I have found rather interesting are *The Basic Stamp* by Kuhnel and Zahnert; *Introduction to Fiber Optics*, by John Crisp; and Lou Frenzel's reissued *Crash Course in Electronics Technology*.

My *Active Filter Cookbook* and *CMOS Cookbook* are stocked at your favorite bookstore as *Newnes* titles. Or autographed from my *Synergetics Press*. Similarly, the *TTL Cookbook* is available locally as a *Macmillan* title or from *Synergetics Press*.

Your local *Newnes* website can be found through *www.bh.com*

Hand Bookbinding Resources

I just wrote up a major update on *Book-on-demand* publishing as my RESBN66.PDF. Your bottom line is that nearly all of the tools and needed techniques are in place for successful low end publishing on demand. The *Hewlett-Packard* 4M+ or 5M+ make acceptable duplexing printers, while their 5SiMX is absolutely ideal. And that cute little *Alps* MD2010 makes a great cover printer.

Binding options are still somewhat limited. Big bucks remain to be made for you if you could come up with a simple and low cost home or smaller scale binding solution. Meanwhile, there is always the obvious route of traditional classic *hand binding*.

I have just run across a bunch of nonobvious tools in this arcane field, so I thought we would cover some of these in our resource sidebar.

I do suspect that the ultimate BOD solution will end up as a mix of hand crafted and commercial techniques.

So there's lots to study here.

More on all this is found in my *Book-on-demand Publishing Kit* Per my nearby *Synergetics* ad. Or on the BOD library shelf of *www.tinaja.com*

Measuring Web Site Hits

Actually, "hits" is a monumentally overinflated concept. For a "hit" is any access to any site at any time for any reason. Your typical visitor will often create a dozen or more hits as background wallpaper, images, bars, buttons, or whatever are grabbed.

But exactly how many left handed Brazilian cat fanciers visited your site at 2 am last Tuesday? Instead of hits, you usually want to know how many user sessions there were. There is all sorts of *hit analysis* software

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HAND BOOKBINDING RESOURCES

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Box 80387
Seattle WA 98108
(800) 201-7575

Gane Brothers
1400 Greenleaf Ave
EG Village IL 60648
(800) 323-0596

Bookbinders Whse
31 Division Street
Keyport NJ 07735
(908) 265-0306

Gaylord Brothers
PO Box 4901
Syracuse NY 13221
(800) 634-6307

Bookmakers
6001 66th Avenue
Riverdale MD 20737
(301) 459-3884

Light Impressions
439 Monroe Ave
Rochester NY 14607
(800) 826-6216

Colophon Book Sup
3046 Hogan Bay NE
Lacey WA 98516
(206) 459-2940

Lindsay Pubs
PO Box 538
Bradley IL 60915
(815) 935-5353

Dover Publications
31 E 2nd St
Mineola NY 11501
(516) 294-7000

Talas
568 Broadway
Ny NY 10012
(212) 219-0770

BOOKS

The Art of the Handmade Book, Flora Fenimore, *Chicago Review Press*, 1992.
Basic Bookbinding, AW Lewis, *Dover Publications*, 1985.
Binding and Finishing, Geoff Porter, *Chapman & Hall*, 1991.
Binding and Repairing Books by Hand, David Muir, *Arco*, 1978.
Book Binding Made Easy, Karen Moore, *University Publishing*, 1994.
Book Binding: Its Background & Technique, Edith Diehl, *Dover*, 1985.
Bookbinding: A Manual of Techniques, P. Richmond, *Trafalgar Square*, 1995.
Bookbinding with Adhesives, Tony Clark, *McGraw-Hill*, 1995.
Bookworks; Making Books by Hand, Gwenyth Swain, *Carolrhoda Books*, 1997.
The Craft of Bookbinding, Manly Banister, *Dover Publications*, 1994.
Creative Bookbinding, Pauline Johnson, *Dover Publications*, 1990.
Cover to Cover: Creative Techniques Making Books, S LaPlants, *Lark*, 1995.
Glue-Binding Your Books, David A Wilson, *Lorien House, 1990.*
Hand Bookbinding: A Manual of Instruction, Aldren A Watson, *Dover*, 1996.
Handmade Books: An Intro to Bookbinding, R Shepherd, *Arthur Schwartz, 1995.*
Handmade Books: A Step by Step Guide, Kathy Blake, *Little Brown*, 1997.
Making Books by Hand: A Step by Step Guide, McCarthy, *Rockport Pub*, 1997.
The Making of the Book: A Sketch, A. Cox, *Oak Knoll*, 1986.

WEB SITES

www.amazon.com *www.redmark.co.nz* *holly.colostate.edu* *www.lindsay.com*

out there of varying cost and quality. And your ISP may also offer custom reporting services.

Most of this software gets based on reading one or more *log files* that are gotten from your ISP.

Figure four shows details.

A *log* file picks up an entry every time your site gets accessed for any reason. Thus, *one line of a log file is one web site hit.*

It may be useful to split the log file line into a grouping of four or more *records*. You can then mix and match the records to extract useful info.

The examples that follow refer to an older *Apache* server. Details may differ with newer technology. But the concept of a readable and extractable log document remains.

The first record is the *url address*. This is usually a "words" style url, such as *charlie.icjb.com*. Sometimes you might see a "numbers" url such as *201.114.162.212* It is tricky to tell which country a numbers url comes from. The url record is everything up to the first "[" in the log file line.

The second record is the exact date and time of day. And is everything from your first "[" in the log file to the second "]".

The third record is the action that was requested. Usually as a page or a graphic to be downloaded. This entry is always bracketed by quotes, and usually starts with "GET".

The final record is everything from the second quote to the end of the log line. This usually consists of a code number followed by a hyphen or a numeric. Code "200" indicates the "successful transfer" and is followed by the number of bytes downloaded. Other codes usually include 001 for *interrupted*, 304 for "use previous cached info", 403 for *forbidden*, and 404 for *not found*.

Figure five shows these codes.

An *error* file might be separate or included as part of the main log file. The *error* file lists only problem hits.

NEED HELP?

Phone or write all your US Tech Musings questions to:

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Box 809-EN
Thatcher, AZ, 85552
(520) 428-4073

US email: *don@tinaja.com*
Web page: *www.tinaja.com*

Such as a *send timeout* or possibly a *read timeout* from slow web routers. Or an *access* error. Possibly caused by misentry or a site foulup.

Error files are particularly useful to pin down problems with your web site. Such as missing, misspelled, or misdirected links. Sadly, an error file cannot normally pin down a broken *external* link *from* your site.

There are two fields in an error log line entry. The first is a date set in brackets. The second is the problem that has occured.

If a problem keeps happening from several different visitors, chances are it is your fault and not theirs. If the problem isn't that obvious, you can always go back into the main log file to find where these folks just came from. Odds are good the problem is on the previous page hit of yours.

On certain newer servers, there's sometimes a third magic file or entry known as a *referral log*. This one will reveal to you the *immediately previous site* your visitor *came from*. And is very useful for tracing how effective site links or ad banners are. The referral logs may need special arrangements through your ISP for access. There may be an extra charge because more comm or access time

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NAMES AND NUMBERS

Alps Electric
3553 North First St
San Jose CA 95134
(408) 432-6000

Analog Devices
PO Box 9106
Norwood MA 02062
(617) 329-4700

Astec Semiconductor
255 Sinclair Frontage Road
Milpitas CA 95035
(408) 263-8300

Burr-Brown
6730 S Tucson Blvd
Tucson AZ 85706
(520) 746-1111

Cards of Wood
PO Box 310
Belmont MI 49306
(616) 887-8257

Chip Scale Review
3099 Orchard Drive
San Jose CA 95134
(408) 383-3653

Crafters Choice
11248 Playa Court
Culver City CA 90230
(800) 421-6692

Dicker International
225 Broadway Ste 2000
New York NY 10007
(212) 962-3232

eg Software/WebTrends
621 SW Morrison #1025
Portland OR 97205
(502) 294-7025

Global Eng Documents
15 Inverness Way East
Englewood CO 80112
(800) 854-7179

NESDA
2708 W Berry St
Ft Worth TX 76109
(817) 921-9061

Newnes
313 Washington Street
Newton MA 02158
(617) 928-2500

Pericom Semiconductor
2380 Bering Drive
San Jose CA 95131
(800) 435-2336

Philips Technical Training
PO Box 555
Jefferson City TN 37760
(800) 851-8885

Synergetics
Box 809
Thatcher AZ 85552
(520) 428-4073

Texas Instruments
PO Box 809066
Dallas TX 75380
(800) 336-5236

might be needed.

One highly useful *indirect* method of measuring site popularity (and a great ego trip) is to determine how many other sites have active links to yours. One easy way to find possible referral links is with the *find url links* feature of *Hotbot*. Another route is to use *Alta Vista*, prefixing with *link:*. Access to these are found on the *Web Resources* page of *www.tinaja.com*.

One fairly impressive commercial analyzer is *Web Trends* sold by *e.g. software*. This one nicely presents an amazing amount of detail. Free 15 day trials are available.

I have written a custom web site analyzer. Mostly for Apache servers. In Postscript, of course. Free at my *www.tinaja.com/psutils/websitan.ps* Read this in an editor or wp, change all the filenames and variables. Then send it to either Acrobat Distiller or GhostScript. This routine could be useful any time you are after highly specialized info. Such as watching a new and obscure page moving on up through the ranks. It is certainly a great PostScript-as-language demo.

New Tech Lit

Unusual data books for this month include an *Astec Semiconductor Data Book* on power supply chips and the *Pericom CMOS Data Book* on many chips, including bus switches. From *Analog Devices*, the *Accelerometer News* newsletter.

From *Lindsay Publications*, a new compendium on *Hot Air Engines*. A well done reprint collection of some 17 patents from 1871 to 1959.

Sadly, hot air engines are just that. First because they get misapplied to woefully inefficient low temperature differential applications.

new from
DON LANCASTER

ACTIVE FILTER COOKBOOK
The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. **$28.50**

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LOTS OF OTHER GOODIES

Tech Musings V or VI	$24.50
Ask the Guru I or II or III	$24.50
Hardware Hacker II, III or IV	$24.50
Micro Cookbook I	$19.50
PostScript Beginner Stuff	$29.50
PostScript Show and Tell	$29.50
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PostScript Tutorial/Cookbook	$22.50
PostScript by Example	$32.50
Understanding PS Programming	$29.50
PostScript: A Visual Approach	$22.50
PostScript Program Design	$24.50
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001 – incomplete

200 – successful transaction
201 – created
202 – accepted
203 – partial information
204 – no response

301 – moved
302 – found
303 – method
304 – use previous cache

400 – bad request
401 – unauthorized
402 – payment required
403 – forbidden
404 – not found
406 – incomplete

500 – internal error
501 – not implemented
502 – temporary overload
503 – gateway timeout

Fig. 5 – SOME HTML error codes.

And secondly, because there is a magic part called a *regenerator* that *nobody* has *ever* figured out how to make. Regenerators have to be short and fat and long and thin. Besides being an excellent conductor *and* an excellent insulator.

Nonetheless, we've now got a fine historical document on a monumental engineering rathole. More on other engineering ratholes is stashed in my RATHOLES.PDF on *www.tinaja.com*

One source for *Bliss Electronics* musical greeting card modules is *Dicker International*

An interesting web site on tv close captioning can be newly reached at *www.caption.com/caption-info.html* The key engineering standards doc is EIA #608. One pricey source for any standard is at *Global Engineering Documents*.

Our new trade journal of the month is *Chip Scale Review*. A brand new *ProService* directory and yearbook is offered by *NESDA*. From *Philips*, a new *Technical Training Catalog* on VCR/Camcorder service and such.

Genuine wood *microveneers* thin enough for laser printing are offered by *Cards of Wood*. There's all sorts of obvious modelmaking possibilities here. Prices start at a dollar per sheet.

Free samples of a wide variety of low energy magnets are available by way of *Crafter's Choice*.

For the fundamentals of starting up your own tech venture, check out my *Incredible Secret Money Machine II*. Per my nearby *Synergetics* ad. You can also preview the intro on my web site. Full catalogs are avilable online at *www.tinaja.com*. Or can be gotten via phone, snailmail, or email.

My web site is now getting some 125,000+ hits per month, so we are now accepting surprisingly low cost commercial banner ads. For details: *http://tinaja.com/advt01.html*

As usual, most of the mentioned items should appear in the *Names & Numbers* or the *Hand Bookbinding Resources* sidebars. Do be certain to check these before you dial up my no-charge US technical helpline that you'll find in the *Need Help?* box. ✦

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